

## Session 1

# Investigating Quadrilaterals

### Materials

- Prepared sets of Shape Cards (from Investigation 1)
- Yarn or string
- Index cards (2)
- Student Sheet 14 (1 per student, homework)

### What Happens

Students play Guess My Shape Rule and sort the Shape Cards by the number of sides. They discuss whether all the three-sided shapes are triangles. Students sort the shapes with four sides in different ways. They write an answer to the question: What is a rectangle? Their work focuses on:

- sorting shapes according to the number of sides
- sorting quadrilaterals in different ways
- identifying rectangles

### Start-Up

**Quick Images** Using the 10 Frames images, flash a 10 Frames number, such as 5, on the overhead. Have students share how many dots there are and how they know. Flash several other 10 Frames images. After each one, students share how they found the number of dots. Encourage comments, such as, “I knew it was 9 because there was only 1 dot missing” or “It’s 6 because the top row and 1 more were filled.” For complete details on this routine, see p. 125.

**Today’s Number** Sometime during the school day, students brainstorm ways to express Today’s Number. Suggest that students use subtraction in each number sentence they write if they haven’t already done so. Add a card to the class counting strip and fill in the next number on the blank 200 chart. For complete details on this routine, see p. 116.

### Activity

## Guess My Shape Rule

Introduce Guess My Shape Rule. This game is similar to Guess My Rule in the unit *Mathematical Thinking at Grade 2*, in which the teacher thinks of different attributes to sort students in the class. In this game, one attribute that is common to some of the shape cards, such as four sides, is used to sort the Shape Cards into groups.

Gather students in a circle and arrange a set of Shape Cards face up.

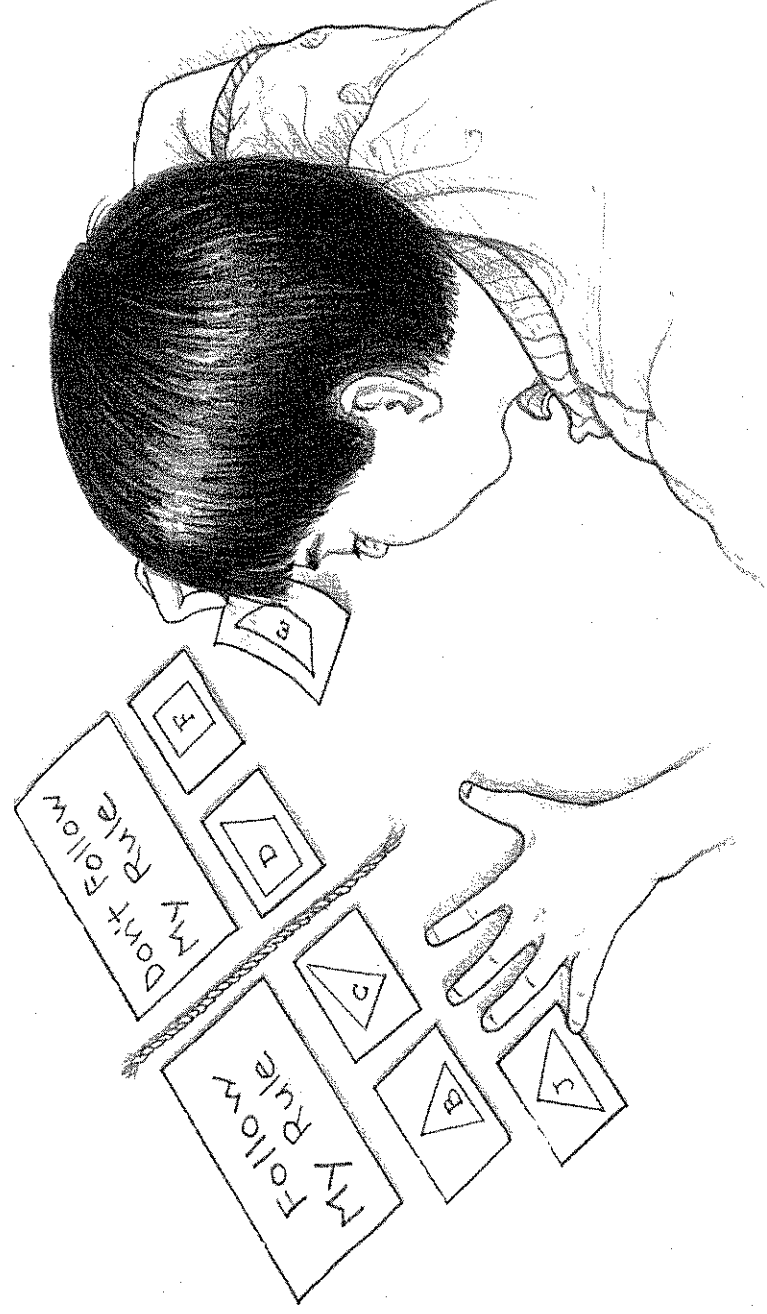
We’re going to use our Shape Cards again to play Guess My Shape Rule. I am thinking of a secret rule about the shape cards. Your job is to figure out what that rule is. Some shapes fit my rule, and some do not. If you think you know what my rule is, don’t say it out loud.

Using the rule **THREE SIDES**, choose a few shapes that fit the rule and a few that do not. Place these shapes in the center of the circle. You can separate the two groups with yarn or string. Write labels for each group on index cards: **FOLLOW MY RULE** and **DON'T FOLLOW MY RULE**. Place the remaining Shape Cards in a pile and ask several students to choose a card.

**Ebony and Tim, please place your Shape Cards on this side of the yarn. These two shapes follow my rule. Paul and Laura, please place your Shape Cards on the other side of the yarn. These shapes don't follow my rule.**

**If you think you have an idea about where your shape goes, raise your hand. Chen, do you think your shape follows my rule or doesn't follow my rule? Yes (or no), your shape follows (or doesn't follow) my rule. Please place your shape on the correct side of the yarn.**

Emphasize the importance of all information—looking at shapes that do not fit the rule as well as those that do. Continue the clue gathering until many students have had a chance to place their shapes.



When most students seem to have a good idea of the rule, ask a volunteer to state the rule and give his or her reasons. Often, students have different ways of describing the same rule, such as triangles or three sides. Sometimes students will come up with a rule that fits the evidence but is not the rule you had in mind. If this happens, acknowledge the student's good thinking even though it did not lead to your secret rule.

❖ **Tip for the Linguistically Diverse Classroom** Ask students with limited English proficiency to point to the common attribute of each shape that they think is the basis of the rule. Identify the attribute orally. When English-proficient students are suggesting a rule, encourage them to also point to the attributes they are noting.

Discuss whether all the three-sided shapes are triangles. Students may disagree about this. For example, some may think that Shapes L and R are *not* triangles because they are long and skinny. Next, remove all triangles and set them aside.

**Now we'll play Guess My Shape Rule without the triangles.**

If students mention that all these shapes have four sides (except Shape D), tell them that four-sided shapes are called quadrilaterals. Don't insist that students learn the word, although some may enjoy adding it to their vocabulary.

Ask one or two students to pick a rule and whisper it in your ear. Play the game several times using their rules. Encourage discussion about whether shapes follow particular rules and whether the rules are clear enough so it can easily be determined whether shapes do or do not follow them.

If you haven't discussed which shapes are rectangles after several students have turns, state that you have another rule. This time place all the rectangles (Shapes A, F, G, M, and Q) by the label Follow My Rule.

Encourage students to discuss what's the same about all the shapes that follow your rule. Some students may call them rectangles; others may disagree, stating that some of them are not because they are squares or too long and skinny. Students may point out that they all have four straight lines, they are not slanty, or they all have four corners. You might have students look at the corners, asking whether the corners in the shapes that follow your rule are different from those that don't follow your rule.

After students have discussed the attributes of the shapes, tell them that mathematicians call all these shapes rectangles. Some students may disagree. See the **Teacher Note**, What's a Rectangle? (p. 50), for a description of second graders' perceptions of rectangles.

## Activity

### Writing: What Is a Rectangle?

As students return to their seats, give everyone a sheet of paper.

**Suppose you wanted to describe a rectangle to someone younger than you. Write what you would tell him or her. [Write on the board, “What is a rectangle?”]**

This activity will provide you with information about students’ current understanding of rectangles. Encourage them to write about what they think about rectangles. If students have difficulty getting started, ask them to tell you out loud and then to write what they said on paper. If some finish quickly with just a brief response, such as, “It’s a shape,” urge them to write more about what they know.

❖ **Tip for the Linguistically Diverse Classroom** To help students respond to the question, help them examine the attributes of a rectangle. For example, count the sides and corners and label them 1, 2, 3, 4. Discuss the length of the sides noting which are the same.

Students can save their writing in their math folders, or you may want to collect them and save them together so you can ask students to repeat the assignment later in the year and compare results.

## Session 1 Follow-Up

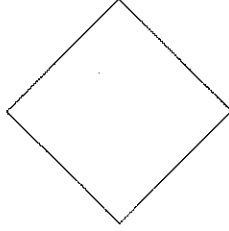
### Homework

**Looking for Quadrilaterals (4-Sided Figures)** Students look for examples of rectangles and other quadrilaterals at home. They find things they can bring to school, such as used envelopes or postage stamps or cut pictures from newspapers, magazines, or flyers. They can draw things they can’t bring in on Student Sheet 14, Looking for Quadrilaterals (4-Sided Figures).

What's so hard about understanding what a rectangle is? The definition of a rectangle seems very clear to us as adults: It is a four-sided polygon with opposite sides parallel and four right angles. If we just show rectangles to students and describe what they are, won't they understand?

Research with students throughout the elementary grades makes it clear that understanding what a geometric object is and how it's classified does not come from learning a definition. Although students hear the definitions of rectangle and triangle all through the elementary grades, and can even repeat those definitions accurately, they still may not agree that an unusual rectangle (for example, a square) or an unusual triangle (for example, a scalene triangle) fits the definition. Definitions of everyday objects often depend on the perception of a typical representation.

For example, some fourth and fifth grade students do not believe that if a square is rotated 45°, it is still a square.



They have an implicit definition, based on seeing many squares presented, that a square must be “sitting” on a side in order to be a square. Similarly, students will argue that a square is not a rectangle—even though they know the definition of a rectangle—because their image of a rectangle is that one of its dimensions must be longer than the other.

In order for students to develop an understanding of a definition, they must examine many examples and counterexamples of the thing they are defining. They must describe, compare, and argue about what is similar and what is different. In order to develop definitions, students must develop the habit of paying careful attention to characteristics; careful observation and description are what we want students to begin to do in this unit.

Asking students to write about what they think a rectangle is provides you with a glimpse into their thinking. It is a record that you can save and perhaps compare with a similar writing assignment done later in the year.

Here are some examples that show the range of student ideas in a second grade classroom:

*Naomi*

A rectangl is a shape that has 4 sides. It is like a square but it is a little longer. it lookes like this peas of paper but a little smaler. A rectangl is long. Sometimes it is a neet shape to work with.

*Tory*

It looks like a square and it has four sides and four korners. A rectange! is Vere long.

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Rosie

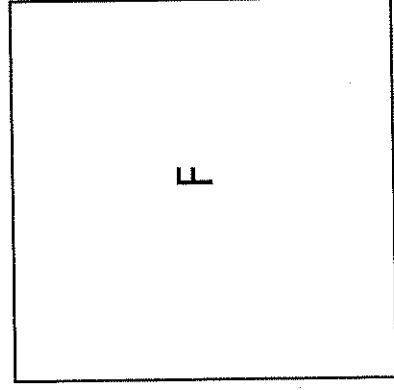
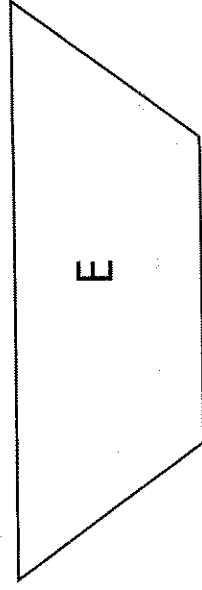
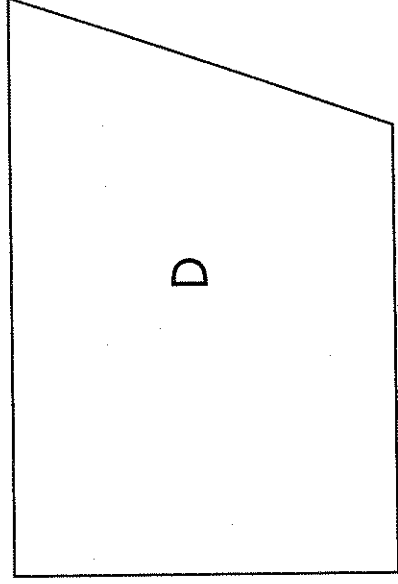
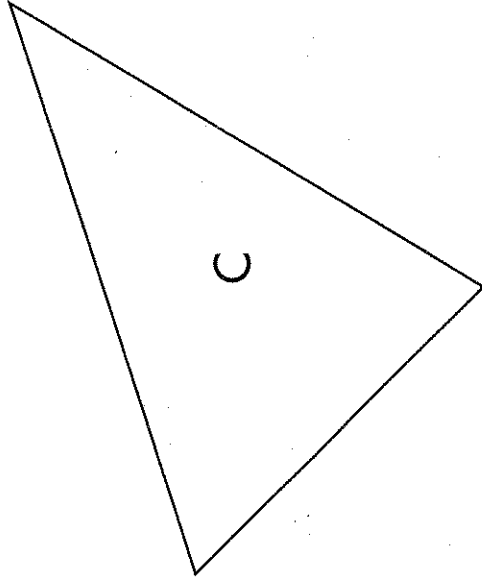
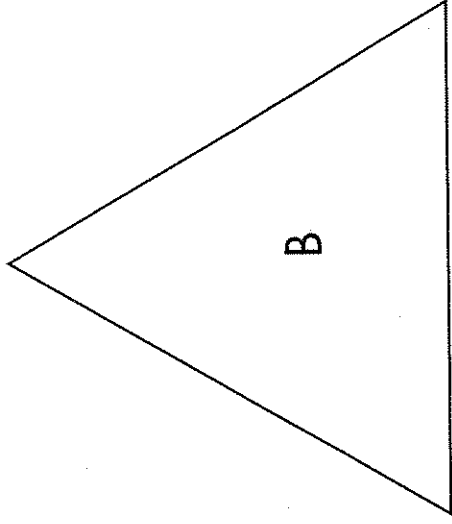
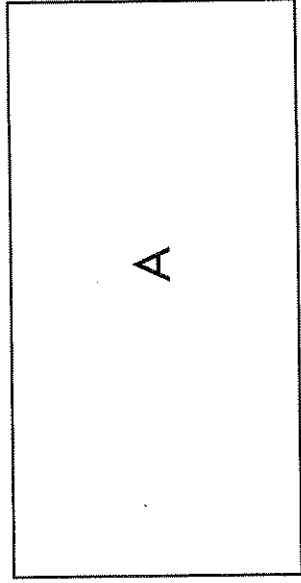
A rectangle has 4 sides.  
It look like a square but  
longer.

Chen

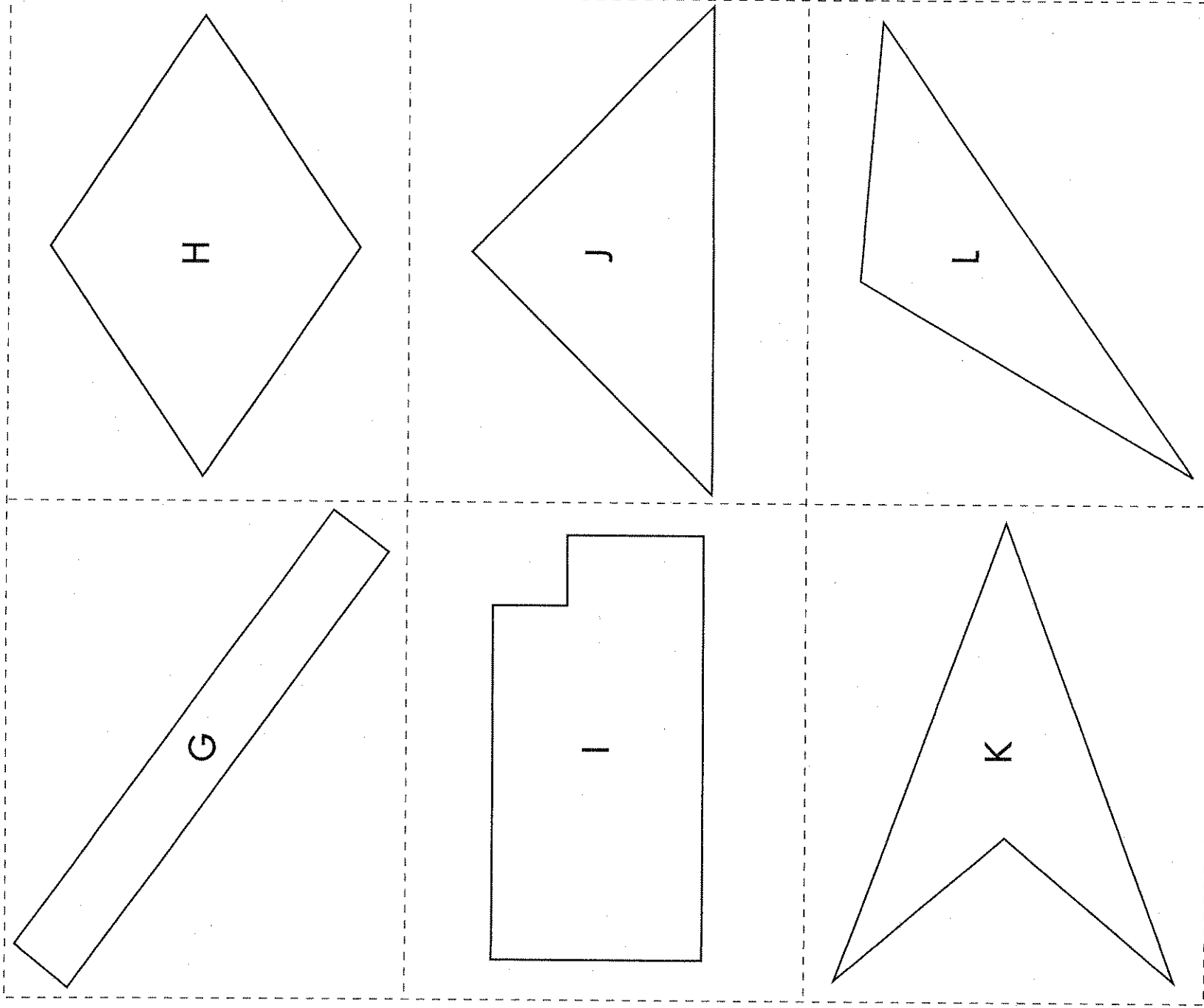
It does not have  
equal sides.  
It is not a square.

A definition of a rectangle is offered by example in Investigation 2, based on the students' experience with sorting quadrilaterals. However, don't expect most students to finish this investigation with a complete understanding of what a rectangle is, or what is included in the definition and what isn't. Rather, as they are working with rectangular arrays to gain more experience with the characteristics of rectangles, expect them to continue considering new examples that arise: Could this be a rectangle? What are its characteristics? What would our definition have to say if this were included?

**SHAPE CARDS (SHAPES A-F)**

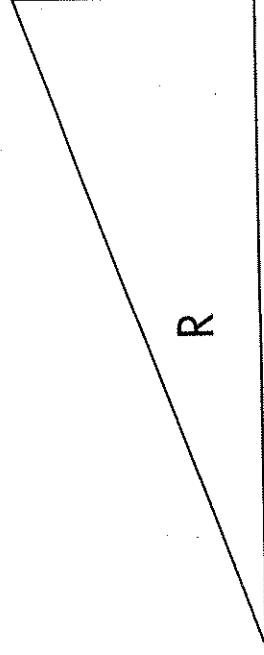
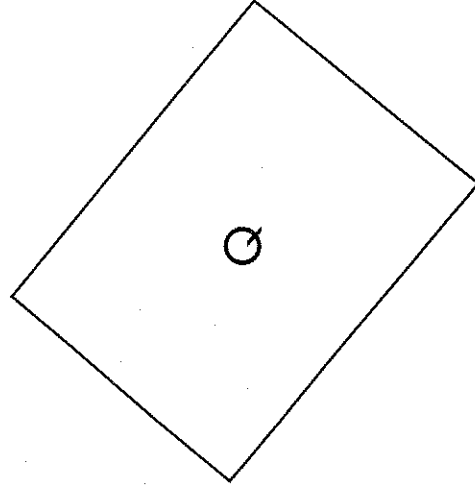
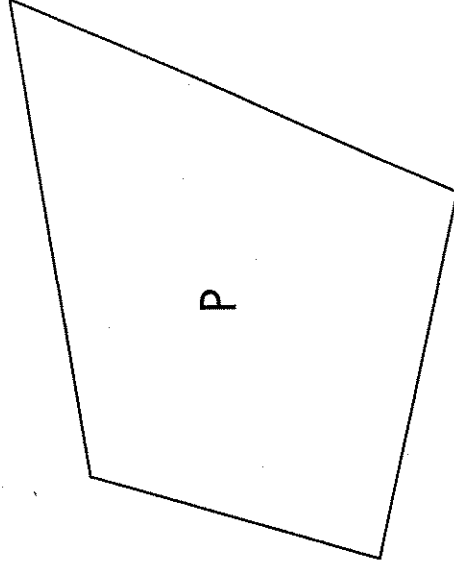
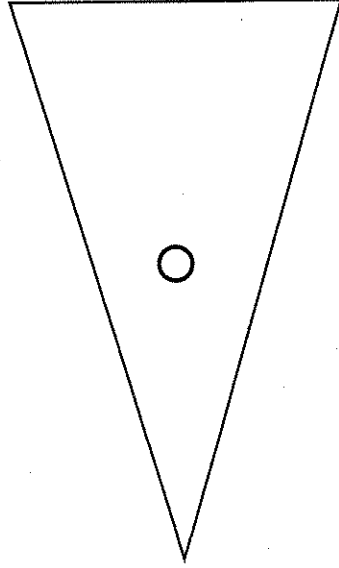
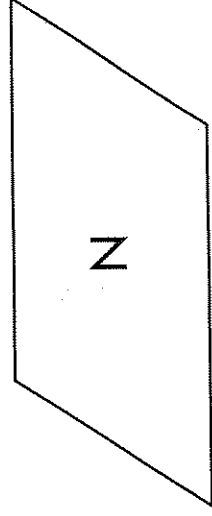
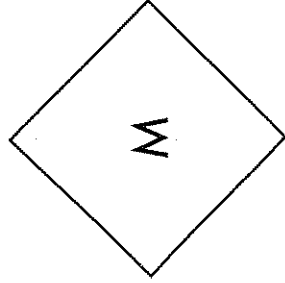


**SHAPE CARDS (SHAPES G-L)**





**SHAPE CARDS (SHAPES M-R)**



## **Looking for Quadrilaterals (4-Sided Figures)**

Look around your home or neighborhood for rectangles and other quadrilaterals. You can also look in magazines for pictures of things that are 4-sided shapes.

If you can, bring some of your shapes to school. If you find quadrilaterals that you can't take to school, draw them here. Use the back of the paper if necessary.